UAVSAR Instrument: Current Operations and Planned Upgrades

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Earth Science Technology Office

UAVSAR

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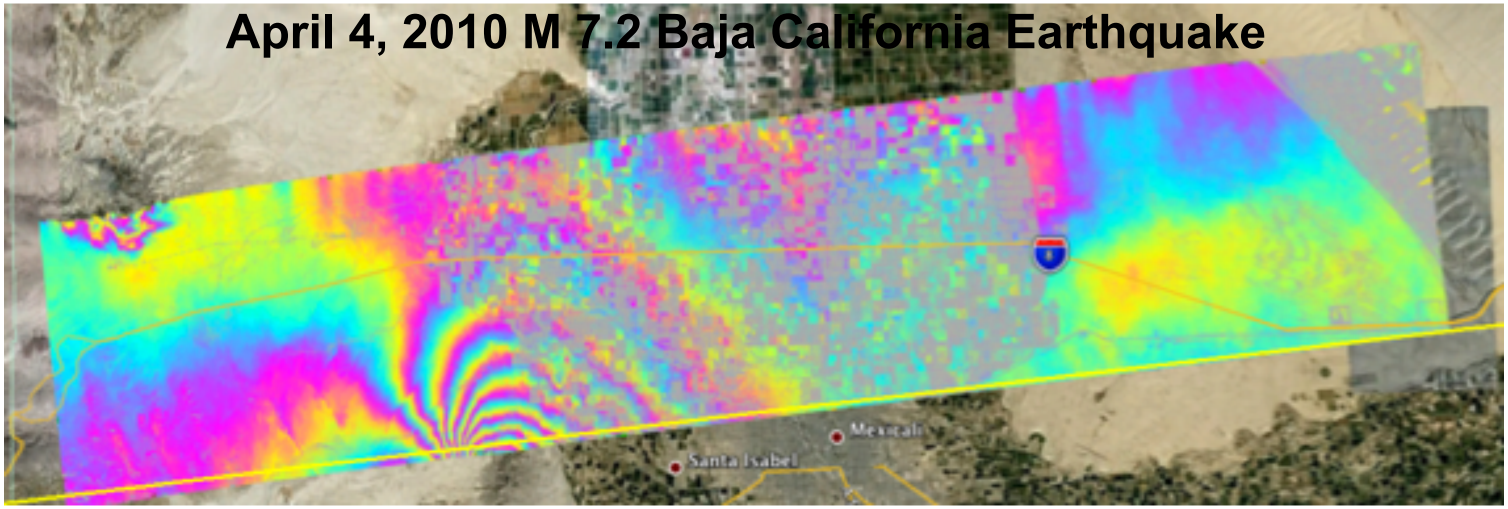


First earthquake deformation captured by UAVSAR using data acquired on October 21, 2009 and April 13, 2010

FY2010 Flight Summary

- 81 flights
- 412 flight hours
- 841 data lines
- 20 TB raw data
- Countries visited: Canada, Haiti, Dominican Republic, Costa Rica, Panama, Guatemala, Honduras, Nicaragua, El Salvador, USA
- Event response: Haiti and Mexicali Earthquakes, Gulf Coast oil spill

Event Response Capabilities

- Earthquake, wild fire, flooding, hurricane damage, volcano

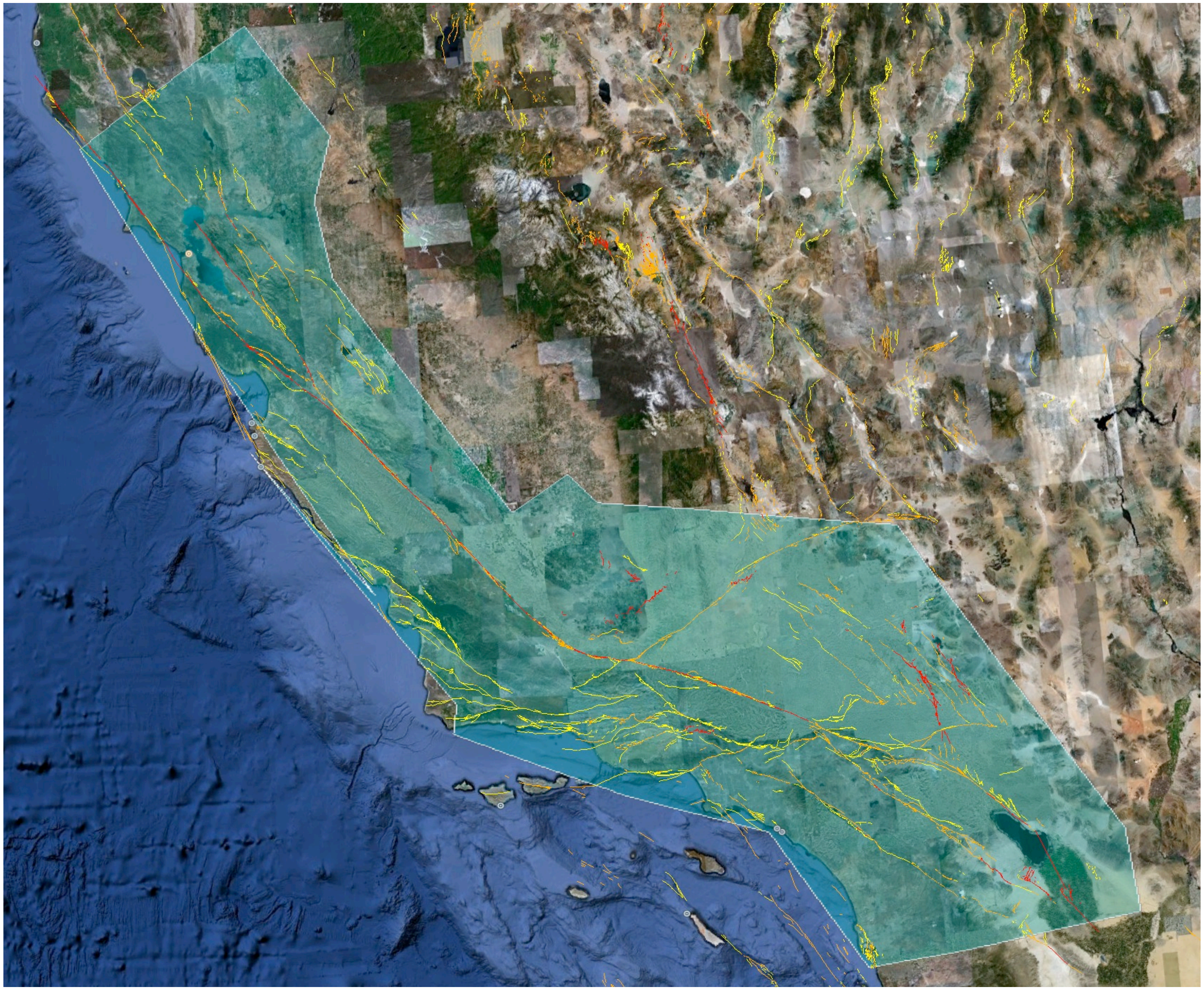
Current Capabilities

- L-band repeat-pass polarimetric interferometry enabled by electronically scanned antenna and precision autopilot that can repeat tracks to within a 10 m tube
- Applications include surface deformation for solid earth, cryospheric studies, vegetation mapping and land use classification, archeological research, soil moisture mapping, geology and cold land processes.

Future Capabilities

- L-band single-pass polarimetric interferometry for topographic mapping and vegetation structure study
- P-band polarimetry for subsurface soil moisture and forest biomass measurements
- Ka-band single pass interferometry for arctic ice study

UAVSAR Coverage of CA Faults



UAVSAR Coverage

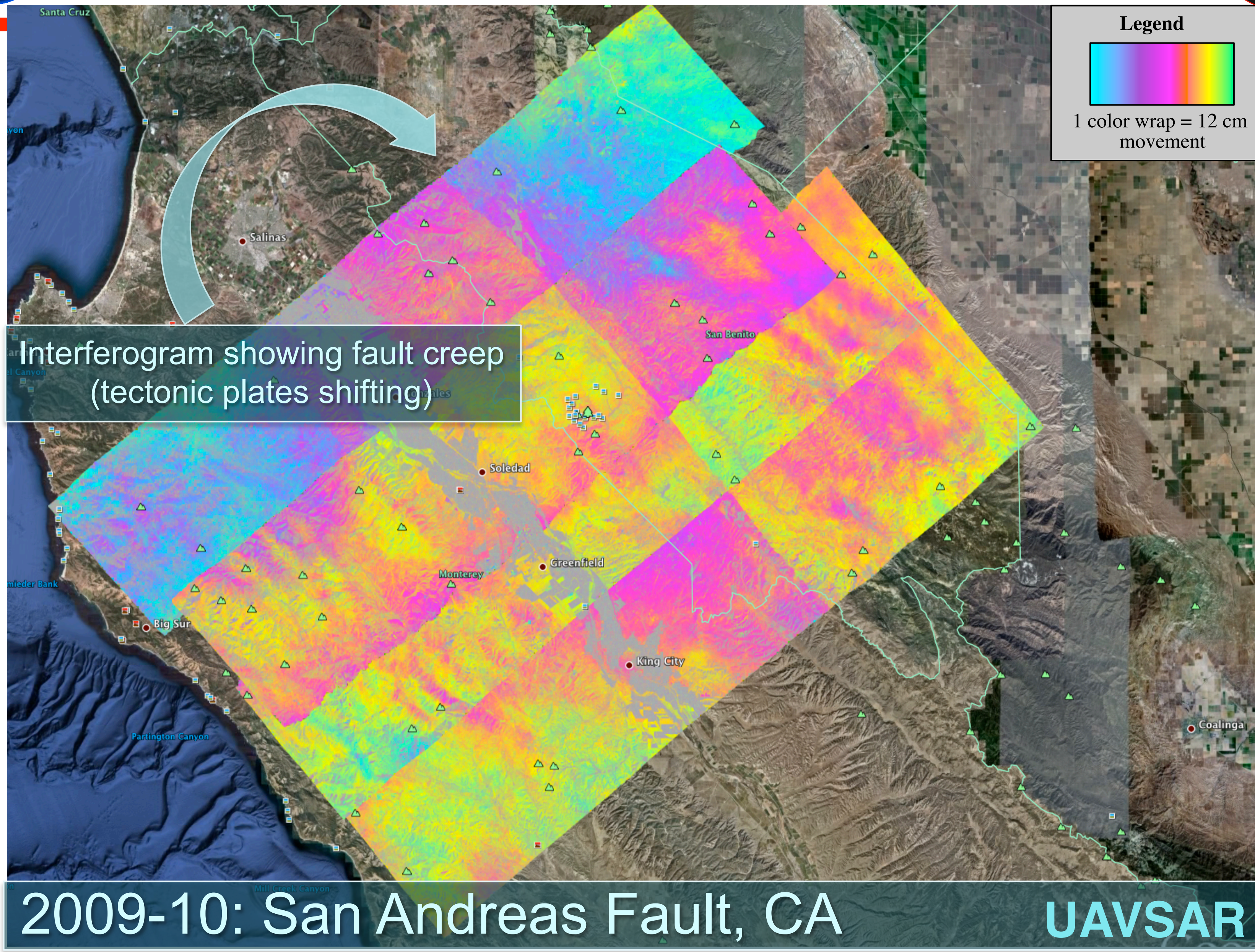
Faults by age of last movement

- < 150 years
- < 15,000 years
- < 130,000 years

Main Faults Studied

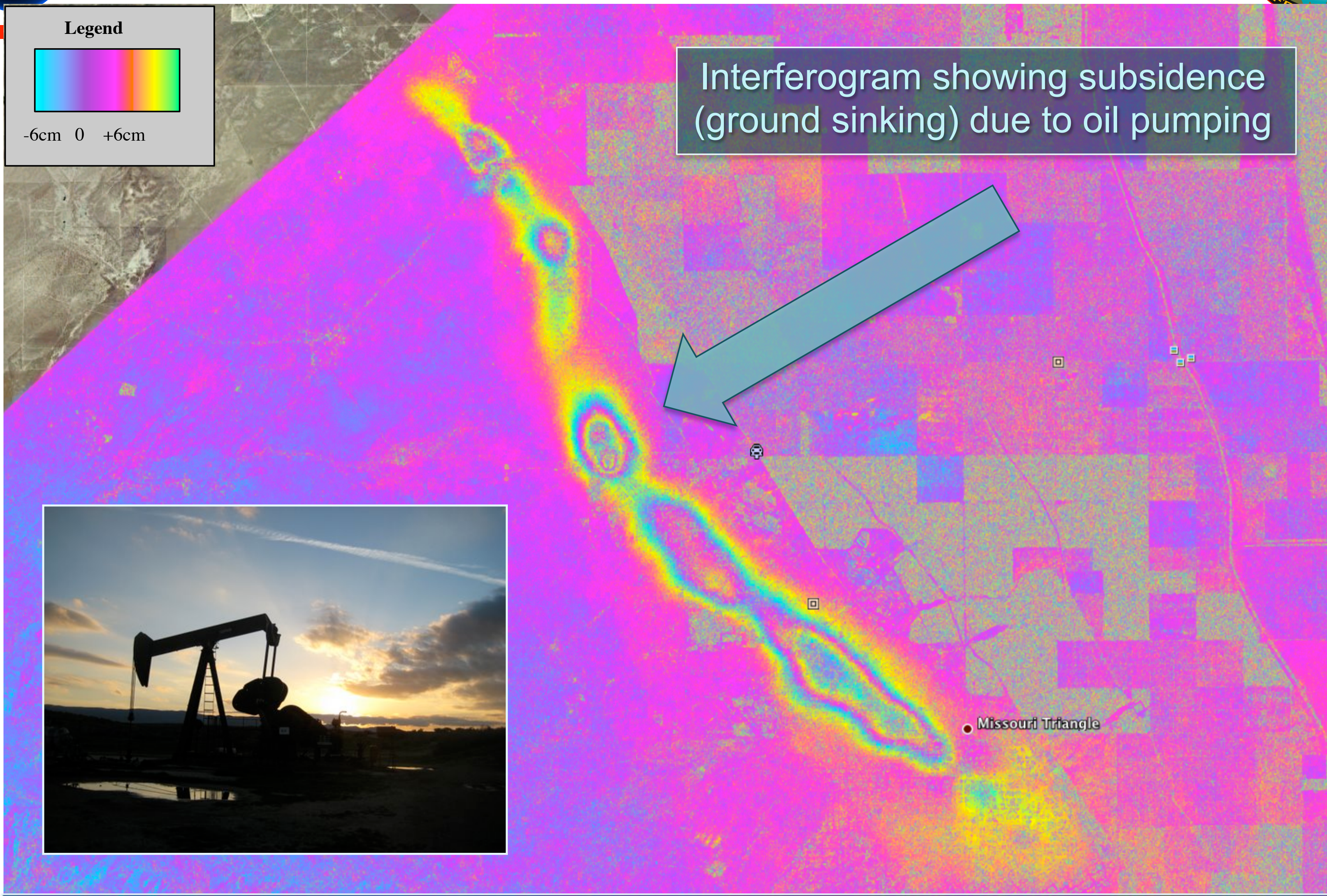
- San Andreas Fault
- Hayward Fault
- Inglewood Fault
- San Jacinto Fault
- Elsinore Fault

San Andreas Fault Monitoring



Note: deformation not absolutely calibrated as phase bias has not been removed from each image strip

Central California Subsidence Study



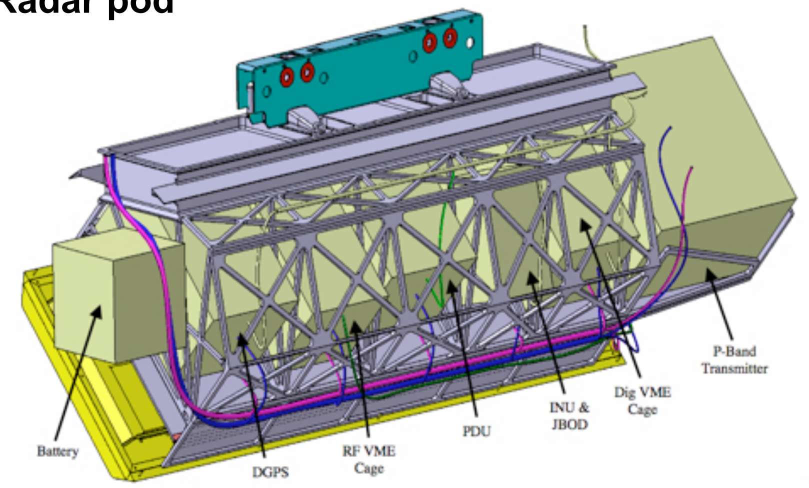
2010-09: Central California

UAVSAR

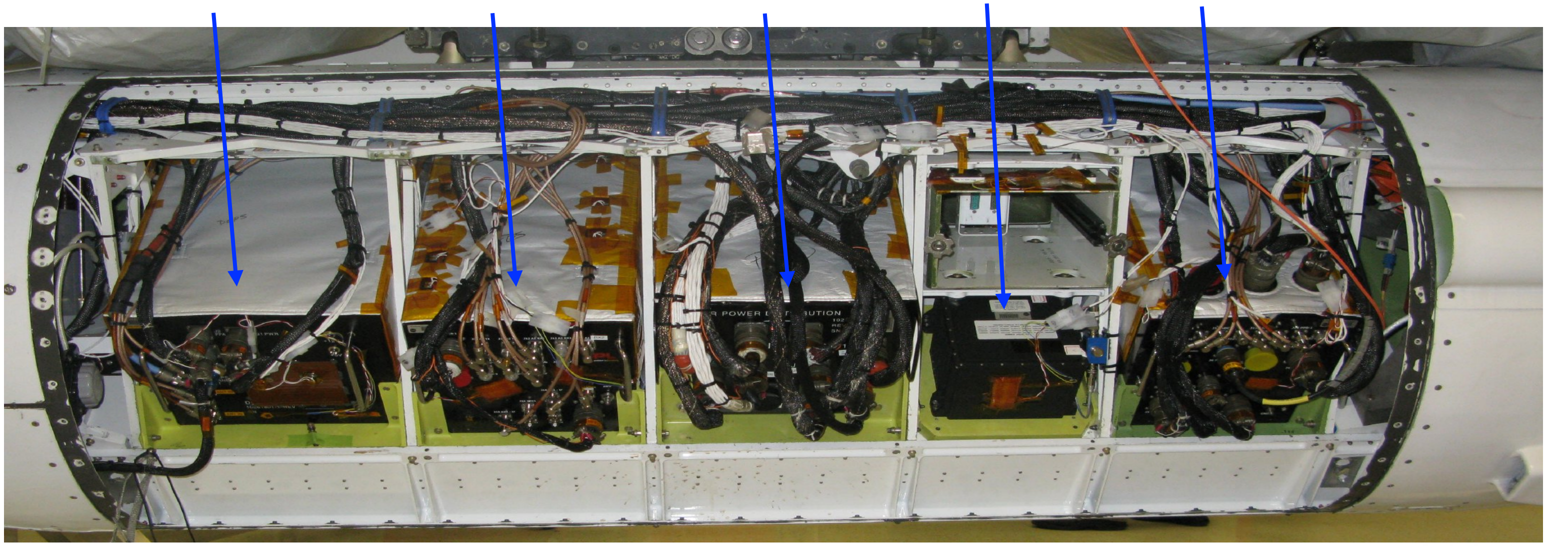
Current UAVSAR Configuration

Gulfstream-III

Radar pod



DGPS RF PDU EGI Digital Subsystem



Key Radar Parameters

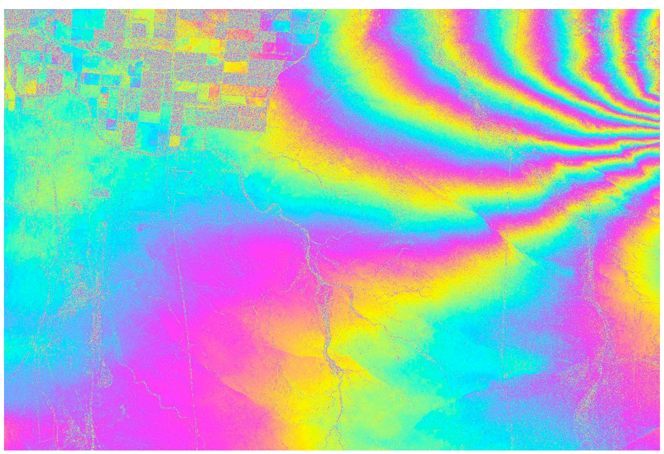
Parameter	Value
Frequency	L-Band 1217.5 to 1297.5 MHz
Bandwidth	80 MHz
Intrinsic Resolution	1.8 m Slant Range, 0.8 m Azimuth
Polarization	Full Quad-Polarization
Nominal Altitude (G-III)	12,500 m (41,000 ft)
Nominal Ground Speed (G-III)	215 m/s
Nominal Spatial Posting	6 m
Nominal Range Swath	22 km (POLSAR), 18 km (RPI)
Look Angle Range	25^o - 65^o
Noise Equivalent σ^o	< -50 dB

UAVSAR- Unmanned Airborne Vehicle Synthetic Aperture Radar

Multi-Frequency, Reconfigurable Imaging Radar Testbed

L-band repeat-pass interferometry

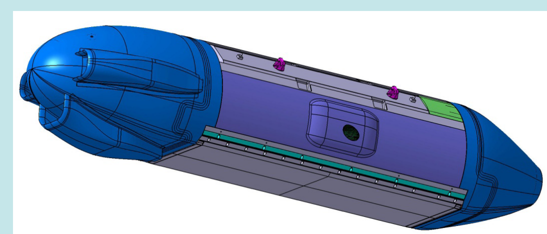
L-band single-pass PolInSAR



Mexicali earthquake deformation captured by UAVSAR using data acquired on October 21, 2009 and April 13, 2010. Major deformation (multiple color wraps) and subtle faulting are visible in the interferogram

Ka-band single-pass InSAR for observing glacier and land ice topography

P-band POLSAR (AirMOSS) for measuring subsurface and subcanopy soil moisture

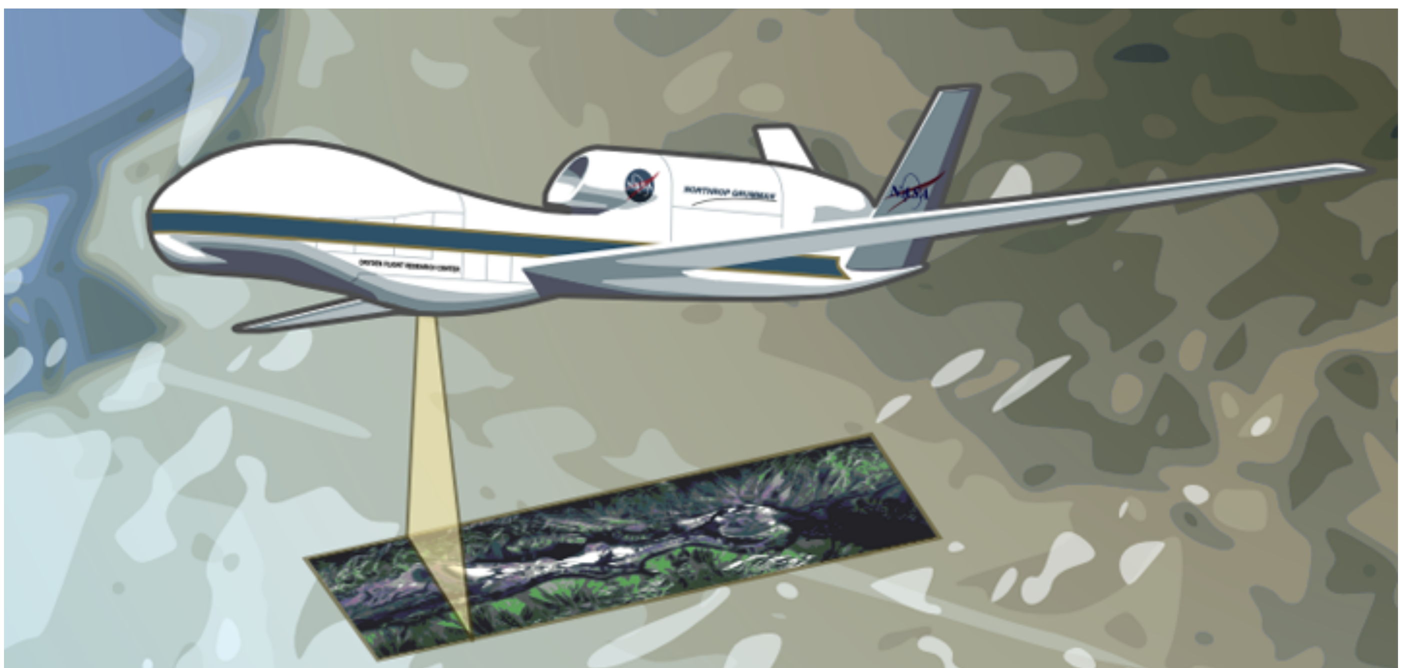


Ongoing Instrument Development

Update on UAVSAR Port To Global Hawk

JPL
Jet Propulsion Laboratory

- Integrate the UAVSAR L-band radar to the Global Hawk UAV Bay 25
- Provide long range (~ 9000 nmi) to enable data collection of distant areas of interest without complicated deployments
- Study the ability of the Global Hawk to accommodate UAVSAR “Mini-Pods” under each wing to enable precision topographic maps and single pass polarimetric interferometry (SPI) providing vertical structure of ice and vegetation.



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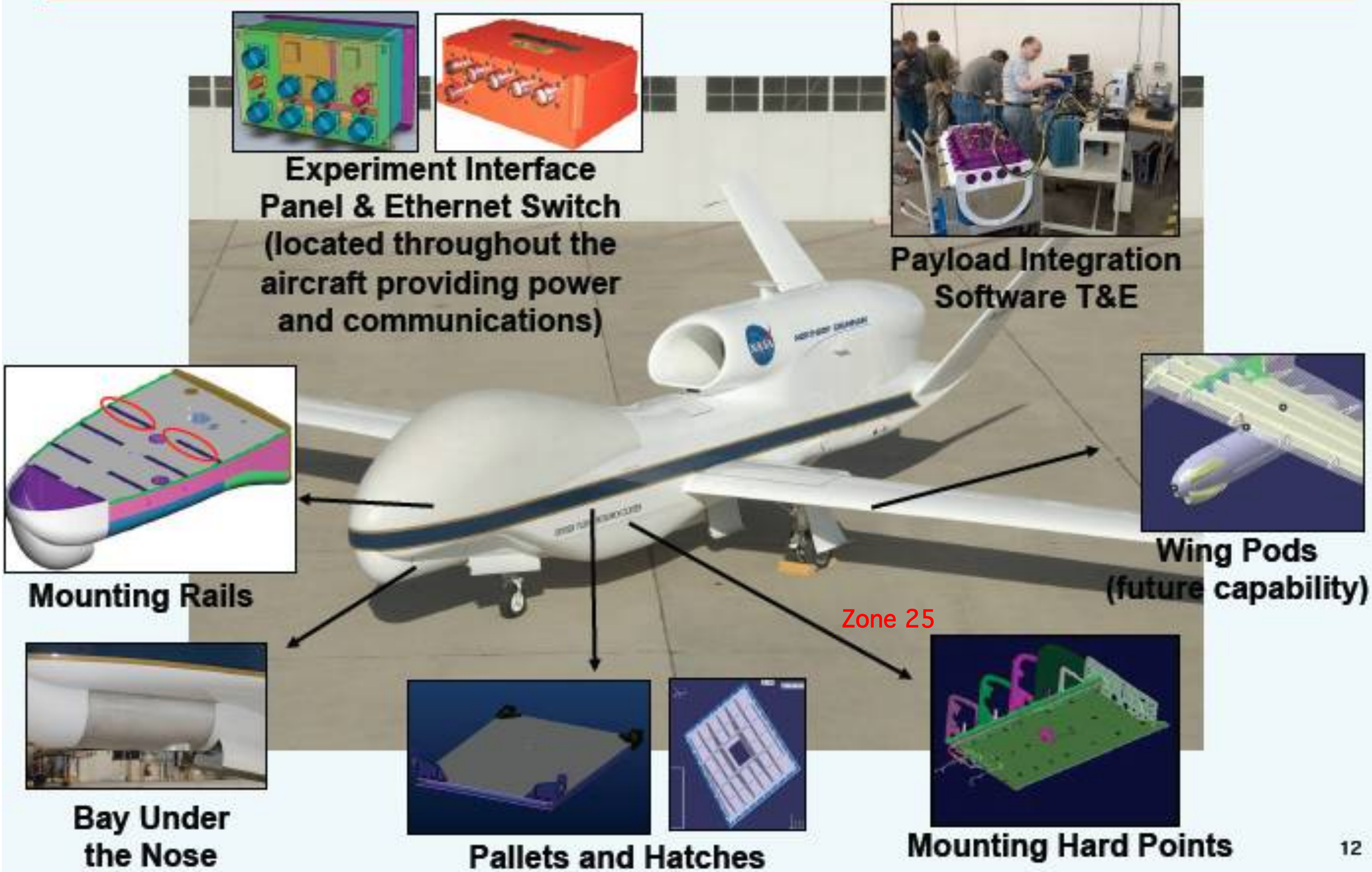
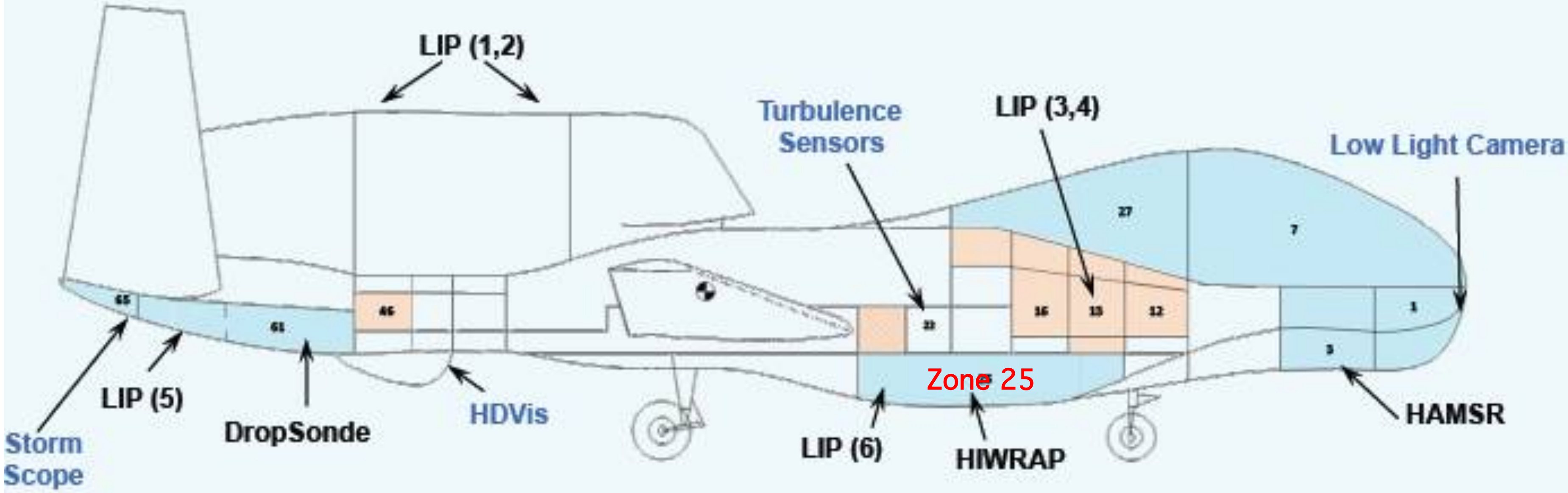
Payload Integration and Accommodations



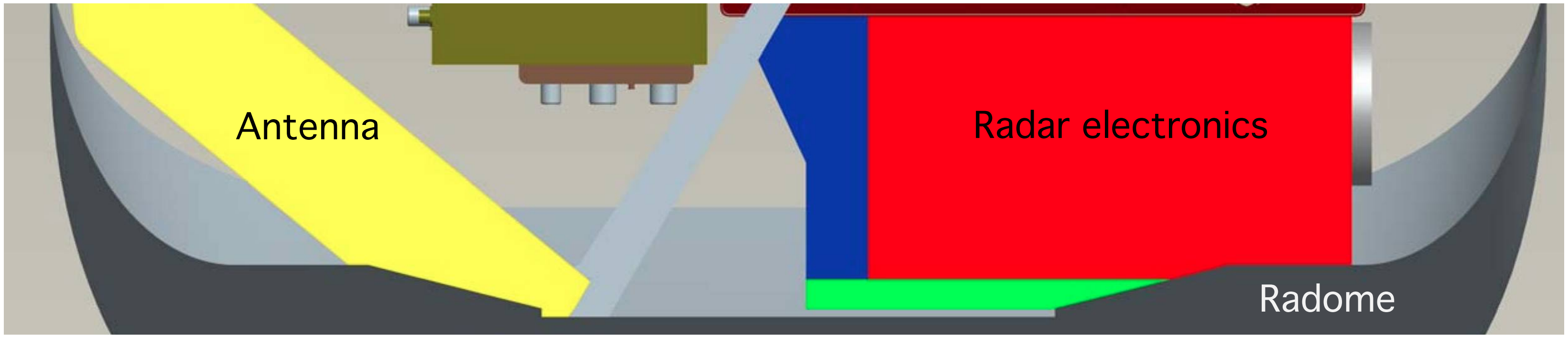
GRIP Instrumentation

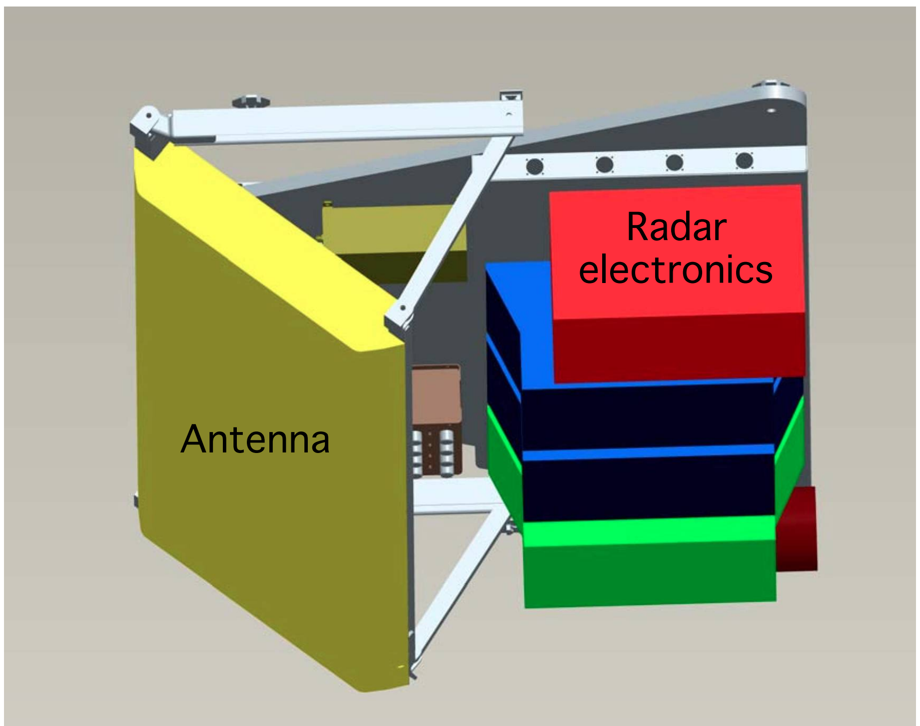


HIWRAP - High Altitude Imaging Wind and Rain Profiler
DropSonde - NOAA DropSonde System
HAMSR - High Altitude MMIC Sounding Radiometer
LIP - Lightning Instrument Package

2 Cameras - HDVis and Low Light for Pilot Situational Awareness
Storm Scope - Lightning Detection Display in the GHOC
Accelerometers - Real-time Turbulence Time-history Display in the GHOC

Instrument Accommodation in Zone 25





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Global Hawk Implementation Steps

Install radar electronics and antenna from master pod to the GH fuselage (i.e. no wing pods)

- Relocate radar electronics into the GH fuselage (zone 25)
- Modify cable harnesses
- Rework thermal accommodation including air cooling of electronics
- Determine antenna performance with new radome (and cant angle)
- Design and fabricate a radome, either existing shape or new shape
- Design and fabricate mounting pallets and structure
- Install all components on aircraft
- Combined Systems Test
- Flight Tests in Edwards Air Force Base Range

If task plans are approved, will begin implementation immediately and plan for flight tests in November 2011.

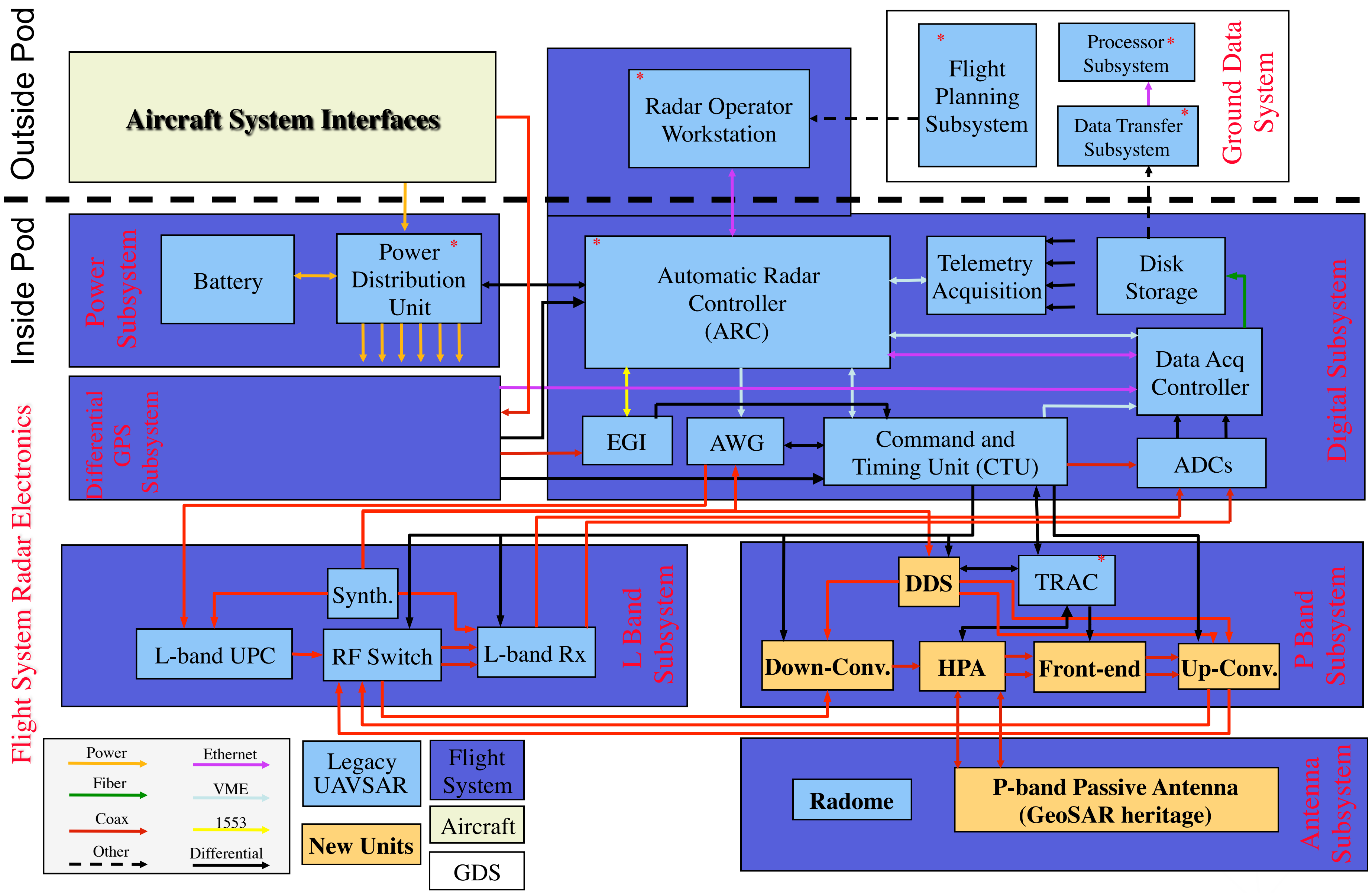
P-band Radar Upgrade Overview

- Build a UHF SAR for root zone soil measurements which
  - Flies on the Gulfstream-III with the same mechanical and electrical interfaces as UAVSAR,
  - Fits in the UAVSAR pod,
  - Reuses as much UAVSAR electronics as possible,
  - Reuses the GeoSAR passive antenna design, and
  - Operates anywhere in the possible 280-440 MHz band since actual frequency allocation is uncertain.

Hardware Highlights

- Reuse the UAVSAR L-band up converter and receiver so down convert from L-band to P-band to transmit and up convert from L-band to P-band on receive.
- Have bank of four filters (6, 20, 40, and 80 MHz) which can be switched in on a pulse by pulse basis to set the bandwidth.
- Use a Direct Digital Synthesizer (DDS) to allow us to change the center frequency on a pulse by pulse basis.
- Use a 2 kW High Power Amplifier (HPA) built by same vendor who built the GeoSAR P-band HPA.
  - Output power limited by need to fit in volume in pod.
- Antenna is 3% smaller than the GeoSAR UHF antenna in order to fit in the pod.

AirMOSS Electronics Block Diagram



*Requires S/W, F/W or H/W Changes

Current Implementation Status

- Conducting design reviews this month
- Major procurements are in place and prototype electronics build has begun
- Breadboard antenna was built and tested
- System integration and test will begin in late 2011 and flight testing is scheduled for March 2012
- Once the radar is flight tested and calibrated, will begin a 3-year campaign to measure root zone soil moisture over 9 North American biomes